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ABSTRACT

Special transportation assistance is currently provided for elderly and handicapped persons in the United States through a variety of programs at the federal, state, and local levels of government. The programs are concerned with improving the mobility of the client groups served, thereby making various activities and locations in urban areas more accessible to them. Relatively little attention has been devoted to assessing the benefits of these mobility and accessibility improvements, however, and legislators and administrators have had virtually no empirical information with which to evaluate and revise the programs. This paper suggests that the benefits of mobility and accessibility improvements for the elderly and handicapped can be expressed largely in terms of the impacts they have on travel behavior. The paper then discusses the special conceptual and practical problems associated with assessing these impacts. Recent data from an experimental transportation program in Danville, Illinois, are used to illustrate the discussion. (Author)

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Mobility, Accessibility, and Travel Impacts of Transportation Programs for the Elderly and Handicapped

by

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ABSTRACT

Special transportation assistance is currently provided for elderly and handicapped persons in the United States through a variety of programs at the federal, state, and local levels of government. The programs are concerned with improving the mobility of the client groups served, thereby making various activities and locations in urban areas more accessible to them. Relatively little attention has been devoted to assessing the benefits of these mobility and accessibility improvements, however, and legislators and administrators have had virtually no empirical information with which to evaluate and revise the programs. This paper suggests that the benefits of mobility and accessibility improvements for the elderly and handicapped can be expressed largely in terms of the impacts they have on travel behavior. The paper then discusses the special conceptual and practical problems associated with assessing these impacts. Recent data from an experimental transportation program in Danville, Illinois, are used to illustrate the discussion.

INTRODUCTION

A variety of programs at the federal, state, and local levels of government currently provide transportation assistance for elderly and handicapped persons in the U.S. These programs typically earmark funds for particular client groups and particular transportation services according to criteria which vary greatly from program to program. Each of these programs is concerned with bringing about certain kinds of improvements in the mobility of the client groups served, and with making certain locations and activities more accessible to them.[1/]

One federal program for which improved mobility for the elderly and handicapped is an explicit objective is that administered by the Urban Mass Transportation Administration (UMTA) and the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (DOT). The regulations for this program use the term "elderly and handicapped persons" to mean:

> "those individuals who, by reason of illness, injury, age, congenital malfunction, or other permanent or temporary incapacity or disability, including those with semi-ambulatory capabilities, are unable without special facilities or special planning or design to utilize mass transportation facilities and services as effectively as persons who are not so affected."[2/]

The client group for this program, then, is composed of persons who have difficulty using mass transportation facilities because of disabilities. By

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1/ Kirby and Tolson (1977) provide a detailed discussion of several of these programs.

2/ U.S. Department of Transportation (1976a).

comparison, certain other federal programs define the elderly as those persons above a certain age, such as 60 or 65, while still other programs limit assistance to those elderly and handicapped below a certain income level.[3/]

The DOT program for the elderly and handicapped provides assistance only for those transportation services which qualify as "mass transportation"; services which are shared-ride and available to the public on a regular and continuing basis. Exclusive-ride taxicab services and services restricted to a particular organizational or institutional clientele apparently could not receive DOT assistance, for example. Other federal programs restrict transportation assistance to certain kinds of trips, such as those to and from medical or educational facilities.[4/]

The legislative objectives of these programs usually allude to levels of mobility or accessibility to be achieved, but rarely provide any quantitative measures of those levels:

> "It is hereby declared to be the national policy that elderly and handicapped persons shall have the same right as other persons to utilize mass transportation facilities and services; that special efforts shall be made in the planning and design of mass transportation facilities and services so that the availability to elderly and handicapped persons of mass transportation which they can effectively utilize will be assured.
>
> ". . . the rates charged elderly and handicapped persons during non-peak hours for transportation . . . . financed with assistance under this section will not exceed one-half of the rates generally applicable to other persons at peak hours. . ."[5/]

3/ U.S. Department of Health, Education, and Welfare (1976).

4/ Ibid.

5/ U.S. Department of Transportation (1975).

"The Secretary shall require that mobility for elderly and handicapped persons is available in each urbanized area requesting a grant or loan under this Act."6/

The above directives from existing and proposed legislation outlining transportation assistance for the elderly and handicapped are all framed in fairly general terms. Decisions on just who should qualify for assistance under the programs and what levels of mobility and accessibility should be provided must be made by agencies interpreting and administering the programs at the federal, state, and local levels. Detailed definitions must be developed, for example, of the kinds of handicaps which inhibit persons from making full use of transportation services, and those wishing to obtain assistance must demonstrate that they qualify under the definitions adopted.7/ And once these eligibility criteria have been established, administrative agencies must decide what kinds of mobility and accessibility should be provided within the directives and funding specified in the legislation.

In order to evaluate alternative transportation programs for the elderly and handicapped, both legislators and administrators need some quantitative measures of the impacts of the programs. In this paper certain kinds of impacts associated with these programs are reviewed, and some specific approaches to impact assessment are discussed. Data from an experimental transportation program in Danville, Illinois, are used to illustrate some of the issues and problems which arise in assessing the impacts of these transportation programs.

6/ Senate of the United States (1977).

7/ U.S. Department of Transportation (1976b).

MOBILITY, ACCESSIBILITY, AND TRAVEL BEHAVIOR

The terms "mobility" and "accessibility" are commonly used to describe objectives and impacts of urban transportation programs. Mobility is generally associated with particular groups of urban residents, and describes their ability to travel from one place to another in an urban area. Accessibility, on the other hand, is associated with locations or facilities, and describes the ease with which they can be reached and enjoyed. Thus we speak of residents who have limited mobility, for example, and of certain locations and facilities which are highly accessible.

It is sometimes suggested that transportation planners are overly concerned with increasing the mobility of urban residents -- through highway construction, expanded bus or rail transit services, or other additions to transportation infrastructure and services. What they should really be concerned about, it is argued, is increasing the accessibility of urban locations and facilities. This latter goal could be accomplished in part by changing the distribution of land uses to reduce the demand for travel, or by changing institutional arrangements such as uniform working hours which place heavy peak demands on transportation facilities. To the extent that these changes could be accomplished, it is claimed, accessibility could be increased without increases in the amount of travel.

Experience to date suggests, however, that efforts to encourage or mandate changes in land use distribution and institutional arrangements are

likely to have only limited effects on the demand for travel. Numerous forces continue to encourage the development of low density suburban housing. Employment, shopping, recreation, education, and health facilities tend to be located where they can be reached conveniently by automobile, the travel mode used by the vast majority of their clientele. The result of this continued low density development is pressure for more mobility as a means of maintaining and increasing accessibility. This pressure is especially significant from those who rely on public transportation services, since the costs of reaching desirable locations and facilities by public transportation increase substantially as land development becomes more oriented to serving automobile users.

The task of increasing the accessibility of urban locations and facilities then, has become largely one of increasing the mobility of urban residents. Despite the wishes and efforts of those who would like to see urban areas structured differently, as a practical matter it seems that only dramatic new land use policies or severe restraints on automobile travel will effect significant changes in current patterns of land development and travel demand. Since such changes will probably occur very slowly (if at all), the current focus on mobility as the major means of increasing accessibility would appear to be quite understandable.

If we accept this view that improving the mobility of urban residents is the major concern of current transportation programs, we can turn our attention to the question of how much mobility should be provided, and for whom. In order to address this question adequately, we must attempt to identify the

benefits and costs associated with various levels of mobility, and the incidence of those benefits and costs throughout the population of urban residents. We will restrict our attention in this paper, however, to the benefits of improving mobility; we will not attempt to discuss the costs associated with different ways of achieving mobility improvements.

As noted earlier, mobility refers to the ability of urban residents to travel from one place to another in an urban area. A variety of different measures can be used to characterize the mobility of a particular resident or group of residents: automobile ownership, possession of driver's license, highway operating speeds, distance from the nearest bus stop, coverage and fare of the bus service, availability and fare structure of taxicabs, and so on. Transportation programs affect mobility by changing the values of one or more of these mobility measures. Two kinds of benefits result from these mobility changes: those derived solely from options for travel, and those derived from trips actually made.

The benefits derived solely from options for travel are difficult to quantify. How much does an urban resident value a publicly supported bus service which he plans to use only when his automobile breaks down, for example? Since several "back-up" travel options are nearly always available in an emergency -- ride as an auto passenger with a friend, borrow a car, call a taxi, or call an ambulance, for example -- the benefits of having additional options provided by transportation programs may not be very great. Experience with fixed route bus services in small communities suggests that the value of the mobility provided by the services is measured primarily in terms of the number of trips actually served; once that number falls below

a certain level, the services are typically discontinued. The option to travel undoubtedly represents some benefits over and above those derived from trips actually made. Assessing the magnitude of these benefits, however, is a task which community planners and decision-makers will probably have to undertake on a case by case basis.

The most tangible benefits associated with mobility improvements are those derived from trips made by urban residents. Travelers value these trips at least as much as the time, effort, and money they expend in making them. Changes in trip-making patterns which take place as a result of transportation programs provide a firm basis on which to assess the benefits of the programs.[8/]

We suggest that the benefits associated with transportation programs for the elderly and handicapped are largely a function of the travel impacts of the programs. Changes in mobility and in accessibility occur by definition when these transportation programs are implemented, but the value of these changes lies primarily in the accompanying changes in travel behavior. Thus, a new bus service may increase both the mobility of certain persons and the accessibility of certain locations and facilities, but the service will not be considered to be of much value unless it is used for a significant number of trips. In the remainder of this paper, therefore, we will be concerned with the problem of assessing the impacts of transportation programs for the elderly and handicapped on the travel behavior of this client group.

8/ See, for example, McGillivray (1975).

TRAVEL DEMAND BY THE ELDERLY AND HANDICAPPED

The Elderly and Handicapped Population in the U.S.

A number of attempts have been made to estimate the number and location of elderly and handicapped persons in the U.S. Perhaps the best estimates currently available are those developed by Abt Associates for the U.S. Department of Transportation.[8/] The Abt estimates are based on population data from the U.S. Census and on "incidence rates" for transportation handicaps obtained from a 1974 national health survey conducted by the U.S. Department of Health, Education, and Welfare. As shown in Table 1, in 1975 an estimated 8,876,000 persons had handicaps which inhibited them in some way from using conventional transportation modes. An additional 17,851,000 persons were 65 years of age or older in 1970, giving a total elderly and handicapped population of 26,727,000 -- about 12.5 percent of the total U.S. population.

An estimate of the elderly and handicapped population of a particular city or urban area can also be obtained by using census data and incidence rates for transportation handicaps. The location of these persons in the area is much more difficult to determine, however. Apart from 1970 census tract, city, and county data on elderly persons, virtually no information is readily available on the location of elderly and handicapped persons in

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8/ U.S. Department of Transpoftation (1976b).

TABLE 1

Abt Estimates of 1975 Transportation-Handicapped Population in the United States

TH Category	Age			
	Under 18	18 to 64	65 & Over	TOTAL
Chronic	190,000	2,927,000	3,791,000	6,908,000
Use Transit with Difficulty	80,000	1,677,000	1,719,000	3,476,000
Cannot Use Transit	110,000	1,250,000	2,072,000	3,432,000
Acute	104,000	419,000	71,000	594,000
Institutionalized	81,000	370,000	923,000	1,374,000
TOTAL	375,000	3,716,000	4,785,000	8,876,000

Source: U.S. Department of Transportation (1976b).

urban areas. This presents a major obstacle to the estimation of travel demand by the elderly and handicapped --- how are we to identify a representative sample of these persons for surveys?

There are a number of different techniques which can be used for locating elderly and handicapped persons in an urban area, though none of them provides really satisfactory results at low cost. They include:

- canvassing on either a random or selective basis;
- obtaining client lists from health and social service agencies, or from private organizations having high memberships of elderly or handicapped persons; and
- so-called "snowball sampling."

Canvassing is the most comprehensive way to locate elderly and handicapped persons. Households are administered a short questionnaire by telephone or in person to determine whether any elderly or handicapped persons reside there. Canvassing can be restricted to those areas (say, census tracts) which are thought to contain high fractions of the client group. Canvassing is likely to require several pre-screening interviews, including some call-backs, per completed interview. Telephone canvassing is less expensive than door-to-door canvassing, but is also somewhat less representative since not all households have telephones.

Lists can be obtained from service organizations or clubs which represent subsets of the elderly and handicapped population. There are two difficulties. First, cooperation and clearance may be difficult to obtain from such organizations due to confidentiality considerations. Second, there is no assurance that persons represented on the lists obtained are similar to those not on them, and it is impossible to estimate even the

number of those not appearing on any list. Lists may also be outdated, incorrect, and overlapping, so that editing would be required before they could be used for sample selection.

Snowball sampling[9/] could also be used to obtain information on the client group -- each person identified would be asked to provide information on other possible members of the group. Snowball sampling may be biased in an unknown way, though it might be a useful adjunct to sampling with lists.

Travel by the Elderly and Handicapped

Given the paucity of information on the number and location of elderly and handicapped persons in the U.S., it follows that information on the travel behavior of this group is even more limited. A recent study for the U.S. Department of Transportation concluded that:

> "there are no adequate empirical data on the travel behavior of the transportation handicapped that would allow for an assessment of their response to system modifications or the installation of new systems."[10/]

The data which do exist have been collected in several different locations for a variety of special purposes. These data do provide some insights, however, into the demand for travel by the elderly and handicapped, and help to illustrate some of the complexities of this particular travel market.

The first point demonstrated by data collected to date is that the elderly and handicapped population represents a very diverse travel market.

9/ Sudman (1976) provides a general discussion of snowball sampling. He does not favor its use in locating rare populations. Its primary value is for obtaining controls for self-selected members of a population under study (such as certain kinds of volunteers).

10/ U.S. Department of Transportation (1976b).

Bunker, Blanchard, and Wachs (1977) analyzed lifestyles and travel patterns for elderly residents of Los Angeles County. They used factor analysis to define homogeneous "lifestyle groups" among the elderly, and then employed analysis-of-variance to identify differences between travel characteristics of the lifestyle groups. (Travel data were drawn from the 1967 Los Angeles Regional Transportation Study.) The results of their analyses, shown in Table 2, provide evidence of significant differences in daily trip rates between lifestyle groups: the "financially secure," for example, appear to average over twice as many vehicular trips per day as the black and Spanish-American communities. Other data collected in Boston by Abt Associates and Wilbur Smith and Associates show daily vehicular trip-making rates for handicapped persons (1.13 trips per day) which differ significantly from those for the general population (2.23 trips per day).[11/]

Overall, then, there is evidence to suggest that certain sub-groups of elderly and handicapped persons make significantly fewer trips than other sub-groups, and than the general population. This evidence raises the following question: how many more trips would the various sub-groups make if their mobility were increased through transportation system improvements? Some attempts have been made to assess this "latent demand" by attitudinal surveys, in which respondents were asked to estimate how many more trips they would make if certain hypothetical transportation improvements were made. Surveys of this kind conducted in Washington, D.C. and Chicago reported that the transportation handicapped would increase their trip-making

11/ Ibid.

TABLE 2

Daily Vehicular Travel of Different Lifestyle Groups among the Elderly in Los Angeles County

Travel Variable	Lifestyle Group: Central City Dwellers	Financially Secure	New Suburbanites	Black Community	Span. Amer. Community	Early Suburbanites	County	F
Percent with Drivers' Licenses	34.55	58.64	48.14	32.89	23.43	45.61	42.49	39.24*
Percent Reporting Vehicular Travel	40.82	55.95	47.84	33.68	31.35	47.11	44.79	19.19*
Auto Driver Trips	.66	1.38	1.04	.56	.40	1.02	.91	23.86*
Auto Passenger Trips	.35	.52	.43	.21	.23	.49	.42	8.58*
Public Bus Passenger Trips	.21	.09	.04	.16	.19	.05	.11	26.06*
Personal Business Trips	.59	.92	.62	.53	.44	.70	.66	12.05*
Trips for Leisure	.23	.43	.30	.13	.09	.29	.27	11.99*
Work Trips	.13	.23	.23	.16	.13	.19	.18	2.36
Shopping Trips	.31	.46	.39	.16	.21	.43	.36	13.03*
Total Trips	1.26	2.04	1.54	.98	.87	1.61	1.47	
Sample Size	1,528	736	706	387	308	2,080	5,768**	

* Statistically significant at the .01 level.
** Includes 23 persons who resided in the Institutionalized Lifestyle Area.

Source: Bunker, Blanchard, and Wachs (1977).

by 0.53 trips per day (Washington) and 0.34 trips per day (Chicago) if convenient, low-cost transportation services were available.[12/] The validity of these estimates is questionable, however, since the reliability of attitudinal surveys of this type is currently unknown.

The present state of understanding of travel demand by the elderly and handicapped does not permit us to predict with any confidence the usage of various transportation improvements which might be made to better serve this client group. This creates difficulties for both the design and evaluation of transportation programs. The design problem is a significant one, though not necessarily crucial to implementing transportation improvements. The demand density for these improvements will be quite low in any case, and adjustments can be made to fleet sizes and service levels as experience is gained from the initial operation of a new program. In the evaluation of alternative transportation programs and policies, however, inadequate understanding of travel demand creates severe problems.

The Effect of Transportation Programs on Travel by the Elderly and Handicapped

In order to evaluate alternative transportation programs for the elderly and handicapped, we need to know what effect they will have on travel by the client group. A complete description of the travel behavior of any particular sub-group of the client group should contain information on the number of trips made by members of the sub-group over a given time period by:

12/ Ibid.

- service characteristics and price of the travel mode used;
- trip purpose;
- time of day, week, and month trips are made; and
- trip origin and destination.

In order to determine the effect of a transportation program on the travel behavior of a particular sub-group, we need to know about significant changes in any of the above descriptors of trip-making. A program might not increase the total number of trips made by a sub-group, for example, but might provide substantial benefits by permitting the trips to be made with reduced travel times, at lower prices or fares, or to more desirable destinations.

There are two possible approaches to obtaining a better understanding of the response of sub-groups of the elderly and handicapped to different kinds of transportation improvements. One approach would collect attitudinal information by questioning selected members of the client group about how they would respond to certain hypothetical transportation improvements. The other approach would collect behavioral information by observing how selected members of the client group actually do respond to the particular transportation services and prices available to them.

The first of the two approaches is fraught with uncertainties about the reliability of the information collected: how does what people say they will do under hypothetical circumstances compare with what they actually would do?[13/] The second approach has the advantage that people would be

13/ Hartgen and Keck (1976) discuss discrepancies between attitudinal forecasts and choices actually made for dial-a-bus services in small urban areas.

asked to report about actual rather than hypothetical trips, though there is still the question of how accurately they would report their trips. (The only way to check on the accuracy of their reporting would be to assign certain individuals to follow them around without their knowledge -- hardly a desirable procedure to adopt.) The major disadvantage of the second procedure is that it is very expensive. For new kinds of transportation improvements not currently in place in any urban area, experimental programs have to be instituted for at least one year and accompanied by detailed measurements of travel responses.

Both of the above approaches have major advantages and disadvantages, and it is not apparent that either is clearly superior to the other. Consequently, it is important that both approaches be pursued. Without continued efforts to collect behavioral travel data, we will be unable to check travel estimates obtained from attitudinal data. And without attitudinal data, it will be a very long time before we obtain any information on likely traveler response to a variety of new kinds of transportation improvements which have yet to be placed in operation.

In addition to the general difficulties of collecting and interpreting travel information, there are a number of special problems associated with obtaining a better understanding of the travel behavior of the elderly and handicapped. The first problem has been discussed earlier -- that of locating the elderly and handicapped members of an urban population in order to select a sample for surveys. Even if such a sample can be obtained, however, another problem is presented by the relatively low rates of trip-making observed for certain sub-groups of the elderly and handicapped

population -- often less than one trip per day. Many elderly and handicapped persons do not work, and their travel is limited to less frequent shopping, social, and recreation trips. Though these trips are undoubtedly periodic, the periods are likely to be much longer than the period of one day associated with work trips.

Behavioral surveys of trip-making by elderly and handicapped persons should be designed, therefore, to obtain a description of each trip made by each surveyed person over an extended period, such as a month. (The first sets of surveys might show that travel by elderly and handicapped persons recurs over shorter periods, though there is little reason to expect this result from data collected to date). Some persons should be surveyed during each month of the year to provide information on seasonal variations in trip-making. Travel diaries would be required, and persons participating in the survey would probably have to be compensated in some way for completing the diaries. An initial payment when the diary was first received might be followed by a second, larger payment when the completed diary was returned. Though this form of travel survey would be rather expensive and difficult to carry out, there does not appear to be any alternative way in which an adequate description of travel behavior could be obtained.

A further problem arises because of the diversity of the elderly and handicapped population. The data given in Table 2 suggest that certain transportation programs such as improved bus service are likely to have a much greater effect on the travel of some sub-groups than on others. The three lifestyle sub-groups in Table 2 with the highest percentages of driver's licenses make significantly more auto driver trips and significantly less

bus trips than the other three sub-groups. Improved bus service might have virtually no effect on the travel of the former three sub-groups but have a substantial effect on the latter three. In order to understand the travel effects of this kind of program, then, we would like to concentrate our in-depth survey efforts on those sub-groups likely to be the most affected. In the case of an experimental program, such sub-groups need to be identified before the program is introduced, so that some prior knowledge is required of the likely impacts of the program.

A final difficulty with assessing the impacts of transportation programs is that of inferring what behavior might have been in the absence of the program.[14/] Use of transportation variables to describe behavior "with and without" transportation programs requires, at the very least, allowances for exogenous influences which might influence trip-making. Indicators such as the area's consumer price index, unemployment rate, and other measures of major employment or construction changes might suggest temporal shifts in the area's economic base or land use and hence in transportation demand patterns. Social programs, tax laws, or transportation policy itself may undergo major revision. Such shifts would require corrections to eliminate bias. For example, a major increase in public transportation supply might cause shifts from auto to public transportation use which are of much greater magnitude than a specialized program for the elderly and handicapped.

In summary, the major problems associated with assessing the travel impacts of transportation programs for the elderly and handicapped are the following:

14/ Campbell and Stanley (1966), Charles River Associates (1972).

- identifying and locating members of the client group in an urban area;
- obtaining individual travel information over a sufficiently long period of time;
- identifying in advance those sub-groups likely to be the most affected by new programs; and
- controlling for exogenous influences.

A transportation program for the elderly and handicapped recently introduced in Danville, Illinois, provides some interesting illustrations of these problems.

A TRANSPORTATION PROGRAM FOR THE ELDERLY AND HANDICAPPED IN DANVILLE, ILLINOIS

A demonstration project funded in Danville, Illinois, by the Service and Methods Demonstration Program of the Urban Mass Transportation Administration, U.S. Department of Transportation, provides some interesting insights into the problems of assessing the effect of transportation improvements on the travel behavior of the elderly and handicapped. The primary purpose of this project is actually to test an innovation in the supply of public transportation services: the application of user-side subsidies[15] to make shared taxi services available at low fares to elderly and handicapped persons. The fairly substantial reduction effected in shared taxi fares for the elderly and handicapped provides an interesting example, however, of traveler response to a major transportation improvement.

Danville, Illinois, is a relatively small city with a population of 46,500. At the time the demonstration project began, December 1, 1975, the city was served by three taxicab companies: Red Top/Yellow Cab with 19 vehicles, Courtesy Cab with 10 vehicles, and Brown Cab with one vehicle. The

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15/ A detailed description of the rationale for this approach to subsidizing public transportation is given by the authors in Kirby and McGillivray (1976). Subsidy techniques are divided into two categories: "provider-side" subsidies paid directly to transportation providers for supplying certain transportation services, and "user-side" subsidies paid directly to transportation users in the form of discounted transportation vouchers. It is suggested that though the more common provider-side subsidies may be easier to administer than user-side subsidies, they have often resulted in dependence of the public on a relatively small number of providers and services. This dependence has tended to restrict opportunities for new providers and to increase costs. User-side subsidies should encourage greater efficiency in service provision by allowing users to choose the providers and services which best meet their needs.

city has no fixed route bus service. However, eleven specialized vehicles are operated by social service agencies in providing transportation for their clients.[16]

Taxi services in Danville are shared ride: that is, two or more passengers with differing trip origins or destinations may share the same taxicab. Fares are based on four concentric zones, with a certain fare associated with each zone. The fare charged for a trip is that corresponding to the origin zone or the destination zone, whichever is higher. For a group of passengers with the same origin and destination, one passenger is charged full fare and each additional passenger is charged a small flat fee. On December 1, 1975, the demonstration project introduced a "charge slip" scheme by which handicapped persons and persons 65 years of age and over could purchase up to $20 worth of taxi rides each month at a discount of approximately 75 percent on each ride. On January 1, 1977, overall fares were increased, and the payments by elderly and handicapped persons were increased to approximately 50 percent of the new fares, with no change in the $20 monthly limit on the total value of rides taken. The payments associated with these fare structures are shown in Table 3.

To date in Danville, then, elderly and handicapped persons have experienced two changes in shared taxi fares: one on December 1, 1975, which amounted to a reduction averaging about 75 percent, and one on January 1, 1977, which amounted to an increase averaging about 100 percent. How could we determine the effect of these quite substantial fare changes on travel by the client group?

16/ Crain and Associates (1977).

TABLE 3

Shared Taxi Fares in Danville, Illinois

Zone	Effective December 1, 1975		Effective January 1, 1977	
	Overall Fare	Payment by E & H	Actual Fare and (% increase)	Payment by E & H and (% increase)
1	$0.75	$0.25	$0.85 (13)	$0.45 (80)
2	$1.25	$0.30	$1.40 (12)	$0.60 (100)
3	$1.50	$0.40	$1.70 (13)	$0.85 (112)
4	$1.75	$0.50	$2.00 (14)	$1.00 (100)

For group riding each additional passenger is charged a flat fee of $0.15.

As discussed earlier, the first step in measuring the effect of transportation improvements on the client group served is to select a representative sample of the group for travel surveys. The firm monitoring the demonstration project, Crain and Associates, encountered the usual difficulties with identifying and locating the client group, and were able only to develop an estimate of the size of the group. This estimate was obtained by adding the number of persons reported to be 65 years of age or over by the 1970 census (5,600) to an estimate of the number of handicapped persons under 65 provided by personnel of local rehabilitation agencies (1,900). The resulting estimate of 7,500 persons constitutes approximately 18 percent of the population of Danville.

In order to obtain shared taxi rides at reduced rates in Danville, a member of the client group must register with the City and obtain an identification card containing his or her name, address, signature, and identification number. This card must be shown to the taxi driver each time a trip is made at the reduced rate. The driver records the passenger's identification number on a charge slip along with the full fare and the reduced fare for the trip. The passenger then signs the slip and pays the reduced fare (and any tip) in cash. As a result of this procedure, a record is obtained of each subsidized trip made by each registered member of the client group.

The registration process for members of the client group and the charge slip procedure for taxi trips provide the basis for much of the travel data collected in the Danville demonstration. When client group members applied to the City for identification cards, they were asked to provide certain

information needed to certify their eligibility for the program. Once a person's eligibility was established, and before an identification card was issued, the person was interviewed by telephone. The person was asked a variety of questions concerning age, sex, race, possession of driver's license, automobile availability, income, and nature of handicaps, if any. This information, when combined with taxi trip information from the charge slips, provided a detailed picture of the use of the reduced fare program by various sub-groups of the client population, as shown in Table 4.

An attempt was also made in these registration interviews to obtain information about the travel behavior of those being registered. Each person was asked to report all trips made over the three days prior to the interview, by purpose and by mode. Analysis of these travel data showed that the mean number of trips reported for each day was significantly greater than the mean number reported for the day before. Crain and Associates concluded that this pattern was due to forgetfulness about trips made more than a day prior to the interview.[17/] It was concluded that the travel data could be used only to describe travel for the one day prior to the interview.

Travel data were obtained through these registration interviews for 2,550 of the 2,600 persons who registered. The data were collected over a registration period of five months, from November 1975 through March 1976. In August 1976 a random sample of 246 registered persons was selected for a follow-up interview, in which travel data were again collected and analyzed.

17/ Crain and Associates (1976).

TABLE 4

Project Person Trips Per User Per Month through July 1976 by Sub-Groups
(Users are those persons who have used the project at least once.)

	Fraction of Total Users	Trips Per User Month
Age/Handicap		
65 & Over, Handicapped	.18	3.7
65 & Over, Not Handicapped	.62	3.1
Under 65, Handicapped	.20	6.1
Alternative Transportation Available		
Not Driver/Receive No Rides	.18	5.9
Not Driver/Receives Rides	.60	4.1
Driver/Auto Avail/Rides	.22	1.3
Ability to Use Taxi vs Bus		
No difficulty either mode	.75	3.8
Taxi less difficult than bus	.21	3.9
Others	.04	3.7
Transit Handicapped and Handicapped		
Problems W/Bus and Handicapped	.18	4.2
Problems W/Bus and Not Handicapped	.07	2.9
No Problems W/Bus and Handicapped	.20	5.5
No Problems W/Bus and Not Handicapped	.55	3.2
Type of Primary Handicap		
Emotionally Disturbed	.08	6.4
Walking Problems/Aids	.07	4.3
Arthritis	.05	4.0
Cardiac Ills	.03	4.6
Mental Retardation	.03	3.4
Blindness	.02	6.3
Household Income Per Person		
Less than $2,500 Per Person	.28	4.1
Less than $5,000 Per Person	.62	3.8
$5,000 to $10,000 Per Person	.09	3.3
Over $10,000 Per Person	.01	3.6

Source: Crain and Associates (1977).

Had there been any substantial changes in the travel behavior of project registrants as a result of the project, they might have been detected from a comparison of the two sets of travel data collected for project registrants before and after their identification cards were issued. The data showed, however, a mean daily trip rate of 1.18 from the registration interview and a rate of 0.99 from the follow-up interview, with a standard deviation of 1.31 in both cases. These figures, which are based on travel data for the one day prior to the interview, show a great deal of variability in the number of trips reported by those interviewed. This variability is presumably due in part to variation between individuals, and in part to the fact that one day is too short a period over which to observe travel by elderly and handicapped persons.

Though the travel data collected for Danville do not permit any statements to be made about the overall effects of the project on travel behavior, information collected by Crain and Associates (1977) on participation in the reduced fare project suggest that there may have been significant impacts on the travel of at least some sub-groups of the eligible population. Of the approximately 7,500 residents of Danville eligible for reduced taxi fares, some 35 percent have registered. A random household telephone survey conducted in August 1976 to obtain socio-economic characteristics of the eligible population in Danville showed that users of the project differed significantly from the total eligible population in two major respects: 78 percent of the users did not drive compared with 51 percent of all eligibles, and 90 percent of the users had incomes under $5,000 compared with 52 percent of all eligibles.

Approximately 80 percent of those registered (28 percent of those eligible) have used the project at least once. Table 4 shows that handicapped users under

65 years of age have taken substantially more project trips per month than other users, and that persons who do not drive have taken substantially more trips than those who are drivers. An overall increase in taxi ridership of 15 percent has been attributed entirely to the project, and fully 30 percent of shared taxi rides in Danville are currently project trips. These figures suggest that about half of the project trips are "new" taxi trips, while the other half are "old" taxi trips being made at the lower fares. Finally, no reduction has been noticed in the patronage of transportation services provided by social service agencies in Danville.

In August 1976, approximately 8,000 shared taxi trips per month were being made under the reduced fare project. This total represents approximately:

- 1.1 trips per month per eligible person
- 3.1 trips per month per registered person
- 3.8 trips per month per user
- 4.5 trips per month per non-driver user (derived from Table 4)
- 6.1 trips per month per handicapped user under 65 (Table 4)

How great a fraction of total travel do these project trips represent for the different sub-groups listed? The best estimate we have of total trip-making is that of about one trip per day (30 trips per month) obtained from the travel surveys of registered persons described earlier. At this rate project trips would account for about 10 percent of total trips for all registered persons, and possibly higher percentages for all users, for non-driver users, and for handicapped users under 65.

It seems likely, therefore, that the Danville reduced taxi fare project has had a substantial effect on the travel behavior of certain sub-groups of

the eligible population. Data collected on the travel patterns of the sub-groups are too limited, however, to permit quantification of this effect. If detailed information about the impacts of future transportation programs for the elderly and handicapped is to be obtained, a much more extensive effort will be needed to measure changes in travel behavior.

The experience obtained from the Danville project provides some valuable guidance for monitoring the effects of other transportation programs for the elderly and handicapped. Much greater effort should be devoted to locating eligible persons using techniques of the type discussed earlier. The extensive user information obtained in Danville provides a basis for identifying in advance certain sub-groups whose travel behavior is likely to be affected to a greater extent than that of the eligible population as a whole.

The sub-groups of interest should be sampled, and both behavioral and attitudinal surveys conducted. The behavioral surveys should collect travel information from each individual over an extended period, such as a month, while the attitudinal surveys would ask individuals about how they expected to respond to the planned transportation improvements. The behavioral surveys would be conducted before and after the implementation of the transportation program, preferably during the same months of two consecutive years to account for seasonal effects. Changes in travel behavior detected by the behavioral surveys would then be compared with responses predicted by the attitudinal surveys.

For transportation programs like that in Danville involving a substantial change in transportation services or fares for the elderly and handicapped

with virtually no exogenous changes which might influence travel behavior significantly, it should be possible to obtain reliable measures of changes in the travel behavior of the sub-groups most affected. Projects of this type appear likely to have quite substantial impacts on certain sub-groups: impacts which could be measured if sufficient resources were applied to data collection and analysis.

CONCLUSION

Transportation programs for the elderly and handicapped are designed to increase the mobility of this client group, and to make a variety of locations and facilities more accessible to them. These improvements can be described in terms of such mobility measures as the travel times and fares associated with traveling between different points in the urban area in question. The benefits associated with these increases in mobility and accessibility are of two kinds: those derived solely from options for travel, and those derived from trips actually made. The benefits of options for travel, while not insignificant, are difficult to quantify, and are probably best judged directly by community decision-makers. The benefits associated with changes in travel behavior are more important and more tangible, though they cannot be assessed without detailed quantitative information on changes in trip-making by particular sub-groups of the elderly and handicapped population.

This paper has been concerned with assessing the impact of transportation programs on the trip-making of the elderly and handicapped. We have pointed out that elderly and handicapped persons tend to make fewer trips than the general population, and that the periodicity in their travel behavior is unlikely to be observed if travel information is obtained only for short periods of no more than a few days. Careful monitoring of the trip-making of a representative sample of elderly and handicapped persons over extended periods will be necessary to increase our understanding of the travel behavior of this client group.

Mounting surveys using trip diaries or other means to obtain behavioral data on trip-making over extended periods is likely to be a relatively expensive undertaking. Attitudinal surveys provide a less expensive but also less certain approach, and in our judgment should be employed in addition to rather than in place of the behavioral surveys. Is the information which would be obtained from these surveys worth the cost? The answer to this question depends on how important it is for decision-makers to know about the benefits of transportation programs to particular groups of residents. Relatively inexpensive ridership surveys can and should be employed to determine who is using a transportation service, how often, and for what purpose. Such surveys cannot determine, however, what the users would do if the service were withdrawn or if new services or fare levels were instituted. Would they take a different number of trips, use other modes, travel to different destinations, or adopt some combination of these alternatives?

Obtaining detailed information about the impacts of transportation programs on the trip-making of different resident groups is an essential step in evaluating the programs. Information of this type will not be available to decision-makers, however, unless research is undertaken to measure travel behavior of particular resident groups over extended periods of time, and to compare these measurements with travel estimates obtained from attitudinal data. Given the current public concern and involvement with improving the mobility of the elderly and handicapped, such research should be given serious consideration in the near future.

REFERENCES

Bunker, James B., Blanchard, Robert D., and Wachs, Martin (1977), "Lifestyles and Transportation Patterns of the Elderly: An Empirical Study of Los Angeles," Los Angeles: School of Architecture and Urban Planning, University of California.

Campbell, Donald T., and Stanley, Julian C. (1966), Experimental and Quasi-Experimental Designs for Research, Chicago, Ill.: Rand McNally and Company.

Charles River Associates (1972), Measurements of the Effects of Transportation Changes, Cambridge, Mass.: Charles River Associates.

Crain and Associates (1976), "Transit Dependent Mobility Measurement," Technical Memorandum prepared for the Transportation Systems Center, U.S. Department of Transportation (unpublished).

Crain and Associates (1977), "User-side Subsidy on a Shared-Ride Taxi Service for Handicapped and Elderly: Danville, Illinois, Demonstration," Menlo Park, Calif.: Crain and Associates.

Hartgen, David T., and Keck, Carol A. (1976), "Forecasting Dial-a-Bus Ridership in Small Urban Areas," Transportation Research Record 563, Washington, D.C.: Transportation Research Board.

Kirby, Ronald F. and McGillivray, Robert G. (1976), "Alternative Subsidy Techniques for Urban Public Transportation," Transportation Research Record 589, Washington, D.C.: Transportation Research Board.

Kirby, Ronald F., and Tolson, Francine L. (1977), "Improving the Mobility of the Elderly and Handicapped through User-side Subsidies," Urban Institute Working Paper 5050-4-4, Washington, D.C.: The Urban Institute.

McGillivray, Robert G. (1975), "Some Thoughts on the Theory of Traveler Benefit Measurement," Swedish Journal of Economics, Vol. 77, pp. 265-272.

Senate of the United States (1977), "S.208 -- A Bill to Amend the Urban Mass Transportation Act of 1964 to Extend the Authorization for Assistance under such Act, and for other Purposes," Washington, D.C.: Congress of the United States.

U.S. Department of Health, Education, and Welfare (1976), Transportation Authorities in Federal Human Services Programs, Atlanta, Ga.: Office of the Regional Director.

U.S. Department of Transportation (1975), Urban Mass Transportation Act of 1964 and Related Laws, Washington, D.C.: U.S. Department of Transportation.

U.S. Department of Transportation (1976a), "Transportation for Elderly and Handicapped Persons," Federal Register, Vol. 41, No. 85 -- Friday, April 30, 1976.

U.S. Department of Transportation (1976b), "Transportation Problems of the Transportation Handicapped," Four volumes edited by Crain and Associates, Washington, D.C.: U.S. Department of Transportation.